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equilateral triangle A B C, Fig. 1, Plate 30, C and A being respectively the centres of the arcs A B, C B. For the lancet arch, bisect the width A B, Fig. 2, in *c*, and produce A B indefinitely to D and E; from A and B, with the radius A C, describe semicircles cutting A B in D and E, the centres from which the arcs are to be described. Let A C, Fig. 3, be the width, and D B the height of the arch; join A B, C B, and bisect the lines A B, C B, and draw through the points of bisection the perpendiculars *g f* and *h e*, meeting the line A C produced in *e* and *f*. From the points *e* and *f*, with the radius *f* A, or *e* C, describe the arcs A *g* B, C *h* B.

To form the drop arch, join A B, Fig. 4, and C B as before, and bisect them; and through the points of bisection draw perpendiculars, cutting A C in *e* and *f*, which two points are the centres of the arcs A B, B C. To describe a four-centred Gothic arch, divide the width of the arch A B, Fig. 5, into four equal parts in *e g f*. Draw A C, B D, perpendicular to A B, and from the points A and B, with the radius A B, describe the arcs A D, B C. Join D *e*, C *f*, and produce the lines to *h* and *k*. Then the points *e* and *f* are the centres of the arcs A *h*, B *k*, and the points C and D of the arcs *h l*, *k l*. The height of the arch in this example is $\frac{2}{5}$ of its span.

For a flatter arch proceed as follows:

Divide A B, Fig. 6, into four equal parts in *e*, *g*, *f*, and draw the perpendiculars A C, B D; from the points *e* and *f*, with the radius *e f*, describe the arcs *e h*, *f h* intersecting at *h*, and through the point of intersection draw *e h*, *f h*, and produce the lines both ways to *k* and D, and *l* and C respectively. Then from the points *e* and *f*, with the radius *e* A, describe the arcs A *k*, B *l*; and from the points C and D, with the radius C *l*, describe the arcs *l m*, *k m*. The height of the arch is $\frac{3}{8}$ of the span.

In Fig. 7 the centres of the arcs A *k*, B *l*, are found as before, by dividing A B into four equal parts, in *e*, *g*, *f*, and letting fall the perpendiculars in this case, not from the extremities of the line A B as before, but from the centres *e* and *f*. From these, then, let fall the perpendiculars *e* C, *f* D, to meet the lines *e h* and *f*, *h*, produced when C and D become the centres of the arcs *k m*, *l m*.

The arch, Fig. 8, is still flatter than the last. The line A B is divided into four equal parts in *e*, *g*, *f*; then from the centres A and B, with the radius A *f*, the arcs *e h*, *f h* are described, and through the point of their intersection the lines *e h*, *f h* are drawn and produced until they meet perpendiculars let fall from *e* and *f*. The arcs A *k*, B *l* are described from *e* and *f*, with the radius A *e*, and the arcs *k m*, *l m* from D C, with the radius D *k*. The height is $\frac{1}{3}$ of the span.

This style of arch can also be constructed as follows: Divide the line A B, Fig. 9, into six equal parts, in the points *e*, *g*, *h*, *k*, *f*. From *e* and *f* let fall the perpendiculars *e* C, *f* D; from the points A and B, with the radius A B, describe the arcs B C, A D, cutting the perpendiculars *e* C, *f* D, in C and D. Draw D *e l*, C *f m*. Then *e* and *f* are the centres of the arcs A *l*, B *m*, and C and D the centres of the arcs *m n*, *l n*. The height of the arch is, like the last, $\frac{1}{3}$ of the span.

To make the crown still flatter than the last figure, proceed as before for the centres of the haunch arches, by dividing A B, Fig. 10, into six equal parts, in *e*, *f*, *g*, *h*, *k*; draw A *m*, B *n*; then from the centres of these arches *e k*, with the distance between them as radius, describe the arcs *e l*, *k l*, and through *l* draw the lines *e l*, *k l*, produced to meet the perpendiculars let fall from *e* and k, in C D. Then the points C and D are the centres of the arcs *m o*, *n o*.

(To be continued.)

◆

Isometric Projection.

We will now explain a method of projecting isometrical circles by means of scales. Draw two lines, *a b*, *b c*, Fig. 1, Plate 31, at right angles, *a c* being equal to *a b*. Take the distance *c a* in the compasses, and set off this distance from the point *a* to the point *d* on the line *a c* produced. Divide *a d*, *a b*, into the same number of equal parts, each of which may represent feet or inches. All isometrical projections of circles being ellipses, the major and minor axes will be found on this scale. Thus, if the distance *a d*—which we suppose to be 11 inches—represents the true diameter of the circle to be projected, then the distance *d b* will be the major axis, and *a b* or *a c* the minor axis of the ellipse or isometrical projection of the circle. The following is a method of using this scale in Fig. 2: Let the line *a b*, Fig. 4, represent the diameter of the circle of which an isometrical projection is required; and suppose, further, that the circle is required to be delineated horizontally, or on the face of the upper plane of a cube, as in Fig. 4. Take the distance *a b*, Fig. 4, in the compasses, and lay it on the line *a d*, Fig. 2, from the point *a*, so as to ascertain the length of it as indicated in the scale. It will in the present case be found to be 8 inches or 8 feet, as the case may be. Take half the distance between the point in the line *a c* and 8 in the line *a b* (which can be done by joining them by diagonal), and set off this from the point *c*, Fig. 4, to the points *d e* on the line *d c e*, which represents the major axis of the ellipse to be constructed. Through the point *c* draw a line *g f* at right angles to *d c e*. Take the distance of four divisions from *a b*, Fig. 2, and set them off from the point c to the points f and g. Through the point c draw a right-hand isometrical line $h\ e\ i$, and through the same point a left-handed isometrical line $j\ c\ k$. Take the distance of four divisions in the line $a\ d$, Fig. 2, from the point a, and set it off from the point c, Fig. 4, to the points $h\ i\ j\ k$. Through the points d, g, f, i, e, k, g, and h, draw by hand the curve of the ellipse. By far the greater portion of the curve may be described by the compasses—these eight points being first obtained as above described—the centres of the parts $j\ f\ i$ and $h\ g\ k$ being found in the line $f\ g$ produced at l and m, and the parts $h\ d\ j$ and $k\ e\ i$ at n and o. These curves described by the compasses will not meet, but the short portion of the ellipse not described by the compasses can very easily be drawn by hand. Fig. 5 shows the projection of the same circle, of which the major axis $d\ c\ e$ is in a right-hand isometrical line. Fig. 6 is the same circle projected on a left-hand isometrical line. The same letters of reference and description apply to those two figures as in Fig. 4.

We have now given a number of examples from which the reader has been able, we hope, to gain a pretty fair notion of the mode of drawing a variety of forms within cubes. The more thoroughly the describing of forms *within cubes* is understood, the more easy will be his practice in another branch of the art, to which we now direct his attention, and in which the tedious modes of obtaining the *direction* and the exact *proportion* of isometrical lines already described are dispensed with, and a mode as simple as it is practically useful is substituted.

In Fig. 5, Plate 15, we gave the mode of constructing an isometrical ruler, $a\ f\ b$, of which both sides are angular; we also show in same figure another form of ruler, having one perpendicular side, the angle being, of course, the same as the angle $a\ f\ e$, or $b\ e\ f$. The reader desirous to practise this species of delineation should construct scales and rulers of convenient sizes of both these forms, and cut them out of black walnut or mahogany. We now propose to explain the mode of using the isometrical rulers. This must be done in conjunction with the common drawing-board and T square, so familiar to all who know any thing about architectural drawing.

Let the line $a\ b$, Fig. 7, Plate 31, represent the upper edge of the T square, which is supposed to be laying along the drawing-board. Take any point c, and moving the isometrical ruler, as in Fig. 5, Plate 15, along the edge $a\ b$ of square till the point coincides with the angular edge of the ruler, draw through the point c a line along its edge, as $c\ d$; this will be a right-hand isometrical line. Move the ruler along the edge of the square till the angle points the other way, and till its edge coincides with the point c, through which draw a line $c\ e$; this will be a left-hand isometrical line. Let $c\ f$ be the length of one of the sides of a cube which it is desired to draw. Set off from c on the lines $c\ d$, $c\ e$, this distance to the points f and g. Adjust the ruler till the angular edge coincides with the points f and g, through which draw lines meeting in the point h; $c\ f\ h\ g$ is the upper side of the cube. From $f\ h$ and g draw perpendicular lines parallel to the diagonal $c\ h$. Lower the edge of square $a\ b$ till it is at a point, say $i\ j$. Then make $h\ l$ equal to $c\ f$, and adjusting the ruler till its edge coincides with the point b, draw isometrical lines along its edge, joining $f\ k$, $c\ m$, in the points $k\ m$. The cube is thus completed.

(*To be continued.*)

The Sectorian System of Hand-Railing.

FOURTH PAPER.

On Plate 26 is shown a platform stairs, with the landing and starting riser on a line with the chord of the cylinder, placing the whole of the cylinder in the platform, thus avoiding the additional labor of curving the nosings, as when worked in the cylinder and thrown partly in the platform. Here the platform is clear of that objection, and all the balusters of the wreath gracefully encircle around the cylinder and find their landing-place on the floor of the platform.

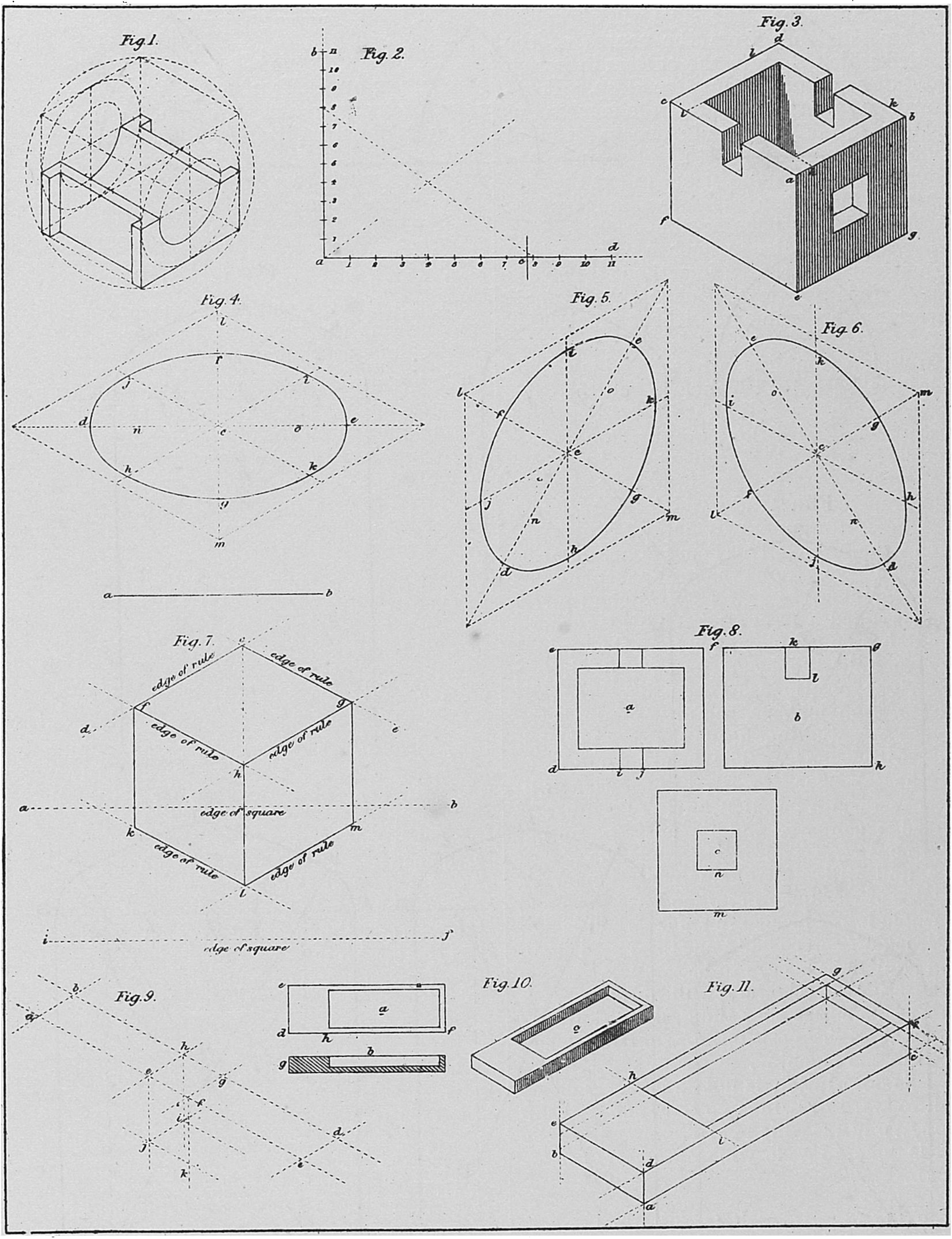
It will be seen that this plate shows a cylinder two feet diameter, and the objection often urged by stair-builders is, that the wreath rises too high for the half riser at the centre of the cylinder, and therefore the steps in the platform cannot be avoided. I claim that, according to the Sectorian System, the difficulty is entirely removed, and the wreath-pieces as easily worked out as any other part of the rail, when properly understood. The wreath-pieces are not required to be any wider in one part than another, and no thicker than the width of the rail in any part. The falling moulds for wreaths in late years have fallen into disuse and are eschewed by most authors on the subject of hand-railing, and I have been uncharitable enough to think it a want of knowledge as to the right use of those moulds, which to this system are indispensable. The wall-string shows my method of bending and keying the same. On other plates it is shown how this wreath is worked.

Hand-Railing.

GEO. W. LONGSTAFF.

Plate 27 represents a flight of stairs with seven windows forming a half circle, with flyers above and below.

PLATE 31.



ISOMETRIC PROJECTION